

REMARKS

I. Introduction

By the present Amendment, claims 1, 5, 10, and 17 have been amended, and claims 7 and 8 cancelled. Claim 21 is newly presented for consideration. Accordingly, claims 1-6 and 9-21 are now pending in the application. Claim 1 is independent.

II. Office Action Summary

In the Office Action of August 11, 2005, claims 1, 2, 6-8, 10-13, 16, and 17 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent 6,344,790 issued to Ochi, et al. ("Ochi"). Claims 3, 5, 9, 14, and 15 were rejected under 35 U.S.C. §103(a) as being unpatentable over Ochi in view of U.S. Patent 4,042,951 issued to Robinson et al. ("Robinson"). Claim 18 was rejected under 35 U.S.C. §103(a) as being unpatentable over Ochi in view of U.S. Patent 5,372,886 issued to Inazawa, et al. ("Inazawa"). Claims 19 and 20 were rejected under 35 U.S.C. §103(a) as being unpatentable over Ochi in view of U.S. Patent 4,742,377 issued to Einthoven. These rejections are respectfully traversed.

III. Rejections Under 35 USC §102

Claims 1, 2, 6-8, 10-13, 16, and 17 were rejected under 35 U.S.C. §102(b) as being anticipated by Ochi. Regarding this rejection, the Office Action states that Ochi teaches first and second electrodes having layers containing copper as the main component. The Office Action further states that Ochi provides a semiconductor element arranged between the first and second electrodes and electrically connected to the first and second electrodes. A glass sealing member seals the first electrode, the semiconductor element, and the second electrode. The Office Action asserts that the first and second electrodes include

ratios of the layers containing copper as the main components that are not less than 20 wt%. The Office Action also cites various passages of Ochi that allegedly support these disclosures.

As amended, independent claim 1 defines a semiconductor device that comprises:

- first and second electrodes having layers containing copper as main components;
- a semiconductor element arranged between said first and second electrodes and electrically connected to said first and second electrodes; and
- a glass sealing member which seals said first electrode, said semiconductor element, and said second electrode, wherein, in the first and second electrodes, ratios of the layers containing copper as main components are more than 20 wt%.

The semiconductor device of independent claim 1 includes first and second electrodes that have layers containing copper as the main components. A semiconductor element is arranged between the first and second electrodes and electrically connected to the first and second electrodes. A glass sealing member is provided to seal the first electrode, the semiconductor element, and the second electrode. Furthermore, ratios of the layers containing copper as the main components in the first and second electrodes are more than 20 wt%. At least one benefit achieved by the invention of independent claim 1 is that the level of adhesiveness between the glass sealing member and the first and second electrodes can be improved. Accordingly, it is further possible to improve the level of tension which the components can withstand.

The Office Action alleges that Ochi discloses all of the features recited in independent claim 1. Applicants review of Ochi, however, appear to suggest otherwise. Ochi discloses an electronic device (such as a thermistor) which has improved corrosion resistance. This is achieved by providing a corrosion resistant material for the lead wires of the thermistor. An exposed portion of

electrodes of the thermistor and a portion surrounding a weld portion of the lead wires are also coated with the corrosion resistant material. See Abstract.

Ochi indicates that dumet wires have been used for sealing electrodes in glass-seal type thermistors. Fig. 2 of Ochi shows a sectional view of an example of the dumet wire to which the patent refers. Ochi goes on to define the dumet wire based on the Japanese Industrial Standards. According to such standards, JIS H4541 (identified in Ochi) relates to a dumet wire of type DW2. This particular dumet wire can be used for various types of semiconductor devices such as diodes and thermistors. Such wires have a ratio of copper that is within a range of 13-20%. These values are illustrated in the copper ratio column of Table 3 in the JIS. Accordingly, the dumet wire described in the background section of Ochi must necessarily contain a copper ratio of 13-20% in order to comply with the Japanese Industrial Standards.

In contrast, according to independent Claim 1, the ratios of layers containing copper as main components are more than 20% in the first and second electrodes. Such a ratio is clearly different from the range specified by the Japanese Industrial Standards. Ochi simply fails to either disclose or suggest features recited in independent claim 1, such as "wherein, in the first and second electrodes, ratios of the layers containing copper as main components are more than 20 wt%."

It is therefore respectfully submitted that independent claim 1 is allowable over the art of record.

Claims 2-6 and 9-21 depend, either directly or indirectly, from independent claim 1, and are therefore believed allowable for at least the reasons set forth above with respect to independent claim 1. In addition, these claims each

introduce novel elements that independently render them patentable over the art of record.

For example, as amended, claim 10 defines that the “ratios of the layers containing copper as main components are more than 20% and equal to or less than 25 wt%.” Such a concentration is clearly not disclosed or suggested by the ratio suggested in Ochi and defined by the Japanese Industrial Standards.

IV. Rejections Under 35 USC §103

Claims 3, 5, 9, 14, and 15 were rejected under 35 U.S.C. §103(a) as being unpatentable over Ochi in view of Robinson. As previously discussed with respect to independent claim 1, however, Ochi fails to disclose certain features recited in independent claim 1. Additionally, these features are also not disclosed by Robinson. Accordingly, the combination of Ochi and Robinson cannot render these claims obvious.

Notwithstanding this fact, Applicants further submit that the features recited in the dependent claims are also not shown or suggested by the art of record. For example, claim 3 provides that the semiconductor element is a diode, while claim 4 specifies that the semiconductor element is a Schottky barrier diode. Furthermore, as amended, claim 5 further specifies that “a sealing temperature of said glass sealing member is 630°C or less and is a temperature at which silicification of said metal electrode of the semiconductor element is not enhanced.” According to such a feature, it is possible to prevent the characteristic of the semiconductor element from changing.

Regarding the references, Ochi appears to be completely silent on any sealing temperature ranges. Robinson, on the other hand, indicates that the sealing temperature should be between 650-700°C. See column 3, lines 15-20.

This is clearly different from, and fails to suggest, the claimed range of 630°C or less.

It is therefore respectfully submitted that claims 3, 5, 9, 14, and 15 are allowable over the art of record.

Claim 18 was rejected under 35 U.S.C. §103(a) as being unpatentable over Ochi in view of Inazawa. As previously discussed, Ochi fails to disclose all the features recited in independent claim 1. Additionally, claim 17 has been amended to further recite that “the copper oxide layers contact with the glass sealing member.” Claim 18 (which depends from claim 17) further defines that the copper oxide layers are 1.5 μm or less.” In contrast, Inazawa discloses a structure for forming CuO and CrO on Cu. This structure, however, does not provide sufficient adherence to the glass. Accordingly, it would not even be obvious to combine the teachings of Inazawa with those of Ochi in order to arrive at the claimed invention. Notwithstanding this fact, Ochi fails to disclose features that are recited in the claimed invention.

It is therefore respectfully submitted that claim 18 is allowable over the art of record.

Claims 19 and 20 were rejected under 35 U.S.C. §103(a) as being unpatentable over Ochi in view of Einthoven. As previously discussed with respect to independent claim 1, Ochi fails to disclose features of the claimed invention. The inclusion of Einthoven as a secondary reference does not appear to remedy this shortcoming.

It is therefore respectfully submitted that independent claims 19 and 20 are allowable over the art of record.

V. Conclusion


For the reasons stated above, it is respectfully submitted that all of the pending claims are now in condition for allowance. Therefore, a Notice of Allowance is believed in order, and courteously solicited.

If the Examiner believes that there are any matters which can be resolved by way of either a personal or telephone interview, the Examiner is invited to contact Applicants' undersigned attorney at the number indicated below.

AUTHORIZATION

Applicants request any shortage or excess in fees in connection with the filing of this paper, including extension of time fees, and for which no other form of payment is offered, be charged or credited to Deposit Account No. 01-2135 (Case: 843.43729X00).

Respectfully submitted,
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